Comparison of Soil Moisture Profiles Between Dense and Friable Till Horizons

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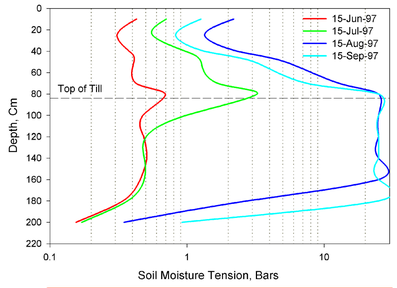


Fig. 1. Soil Moisture Tension, Wabeno - Friable Till (Jun-Sep)

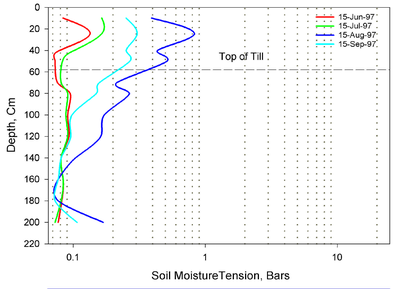


Fig. 2. Soil Moisture Tension, Magnor - Dense Till (Jun-Sep)

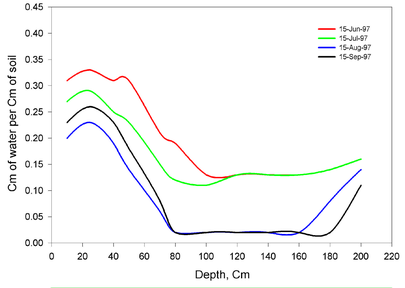


Fig. 3. Soil Moisture Volume, Wabeno - Friable Till (Jun-Sep)

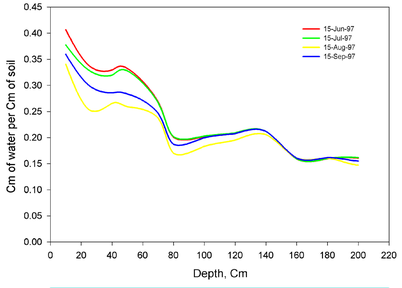
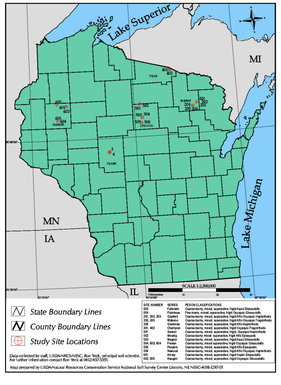


Fig. 4. Soil Moisture Volume, Magnor - Dense Till (Jun- Sep)



Introduction

The objective of this paper is to compare the soil moisture tensions and soil moisture content of northern Wisconsin soils formed in friable and dense tills. Of the fourteen soil series represented in the project, eight series are formed in friable till and six in dense till.

In this paper, friable till soils are represented by data from a Wabeno pedon (Coarse-loamy, mixed, superactive, frigid Alfic Oxyaquic Fragiorthod). The physical properties for the Wabeno are shown in Table 1. Similar data representing the dense till soils are from a Magnor pedon (Coarse-loamy, mixed, superactive, frigid Aquic Glossudalf. The physical properties of the Magnor pedon are shown in Table 2. The vegetation at both of these sites is mixed hardwoods (Photo 1). Data from a Freeon pedon (Coarse-loamy, mixed, superactive, frigid Oxyaquic Glossudalf), which is similar to Magnor, is also shown to represent soil moisture changes over several years.

The project history and instrumentation have been described by Hvizdak, et al.

Methods

Soil moisture tension values are obtained from resistance-type soil moisture sensors (Photo 2). Data are stored as two-hour averages from twelve soil depths. We used the laboratory characterization data from each pedon to calculate soil moisture by volume using the methods of Baumer and Brasher (1982).

We report detailed data for 1997 (the year in which soils became the driest) and generalized data for 1995-1999. Precipitation data were obtained from the nearest weather stations. We have chosen the months of June-September to represent the major part of the growing season.

Results

Figures 1 and 2 show the soil moisture tension for June-September 1997 for soils with friable and dense till, respectively. The soils in friable till had soil moisture tensions greater than 15-bar compared to tensions no greater than 1-bar in the dense till soil. Some dense till soils at other sites approached 2-bar tensions, but never approached the high tensions of the friable till soils. Friable till soils at other sites also had moisture tensions exceeding 15-bar in 1997.

Figures 3 and 4 show growing season soil moisture contents. In the friable till soil, Wabeno, the amount of soil water between 80 and 160 cm approaches zero. The driest part of soil coincides with the depth of the 2B/Ex1 horizon, the top of which is the lithologic change to the friable till material. By contrast, the amount of water in the dense till soil, Magnor, dries much less with a minimum moisture of about 0.15 cm per cm of soil. The soil moisture remains fairly constant in the till material (below 58 cm) and the effect of the lithologic change is less sharply defined than in the Wabeno.

Figures 5 and 6 show soil moisture tensions for several years. Although the friable till soils dry to depth in some years, there are years when no horizons have soil moisture tensions more than 2-bars (1996, 1999), shown in Figure 5. By contrast, soils in dense tills did not ever have soil moisture tensions as high as 2-bars in any of the years of our study, shown in Figure 6.

Figures 7 and 8 show the volume of water in the 10-200 cm profile depth from June through September. *Note: The scale is different on these two figures.* These data again show the large contrast of soil water depletion in 1997. In the friable till Wabeno, soil moisture decreases at an increasing rate from June through August and the soil moisture remains very low through September. Precipitation appears to have little effect on the depletion of soil moisture. By contrast, the soil moisture in the dense till Magnor profile does seem to change in response to precipitation events. The large difference from the Wabeno, however, is that the drying is much less (the range is about 6 cm) and soil moisture increases beginning in August.

Conclusions

- In 1997, the soil moisture tension in profiles of soils with friable tills exceeded 15 bars whereas profiles of soils with dense tills did not exceed 2 bars. Similar patterns have been observed in the last four years.
- None of our data show dense till soils drying to more than 2-bar soil moisture tension any year at any depth.
- In some years, friable till soils remain at <2-bar tension throughout the year.
- The maximum net decrease in soil moisture from June through September 1997, was about 6 cm in the dense till soils compared to 22 cm in the friable till soils.

Photo 1. Study site of a Freeon silt loam in a hardwood forest in Lincoln County.

Photo 2. Colman steel-encased fiberglass soil moisture sensor.

Table 1. Wabeno Soil Properties - Friable Till (Coarse-loamy, mixed, superactive frigid Alfic Oxyaquic Fragiorthod)

Horizon	Depth (cm)	% Clay	% Silt	% Sand	Db	Structure	Roots
Bs	0- 61	7.7	57.8	34.5	1.14	1, f, m sbk	3-f, 2-m, 1-c
E/B	61-84	7.6	57.9	34.5		1 tn, pl	2-f, vf; 1-m
2B/Ex1	84-160	5.9	14.8	79.3	1.79	2 tk, pl	1-f, vf, m
2B/Ex2	160-236	6.8	11.8	81.4	1.78	2 tk, pl	1-f, vf

Table 2. Magnor Soil Properties - Dense Till (Coarse-loamy, mixed, superactive, frigid Aquic Glossudalf)

Horizon	Depth (cm)	% Clay	% Silt	% Sand	Db	Structure	Roots
A	0-10	30.3	61.2	8.5	0.71	2, f, gr	1-c, 2-m
E1	10-20	14.3	71.0	14.7	1.41	1, f, pl	1-c, 2-m
E2	20-33	9.0	71.5	19.5	1.51	1, f, pl	1-m, 1-c
E/B	33-58	14.2	59.0	26.8	1.61	1, m, pl	1-m, 2-f
2B/E	58-76	9.4	34.9	55.7	1.79	1, f, sbk	2-f
2Bt/1	76-114	6.7	24.8	68.5	1.78	1, co, pr	1-f
2Bt/2	114-145	12.6	25.5	61.9	1.83	1, co, pr	1-f
2Cd	145-213	9.9	24.0	66.1	1.93	m	--

References

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Baumer, O.W. and B.R. Brasher. 1982. Prediction of water contents at selected suctions. ASAE paper 82-2590, ASAE, St. Joseph, Missouri.

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Fig. 5. 1995-1999 Soil Moisture Tension, Wabeno - Friable Till

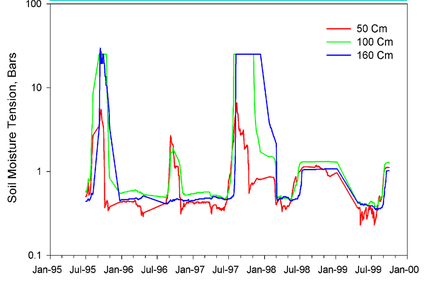

Fig. 6. 1996-1999 Soil Moisture Tension, Freeon - Dense Till

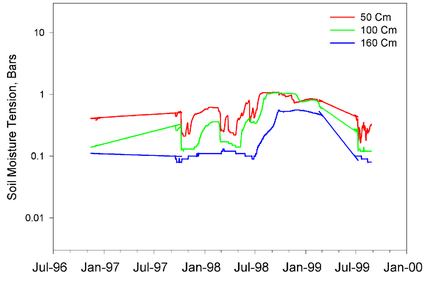

Fig. 7. Volume of Soil Water in Profile and Precipitation, Wabeno - Friable Till

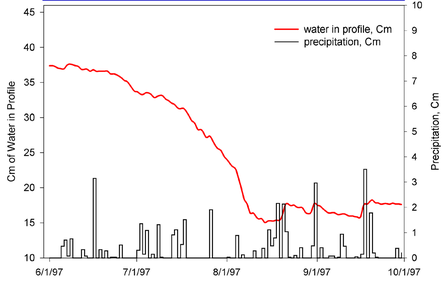

Fig. 8. Volume of Soil Water in Profile and Precipitation, Magnor - Dense Till